

Exploration of Viewpoints in Identification of Gymnastic Talent with the Back Hip Circle

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Abstract: In Japan, students attempt the back hip circle in physical education class in school. It is considered a simple teaching material with which children can experience feelings of achievement and pride. A major factor behind this is that schoolyards in Japan do not have an environment for gymnastics, equipped only with horizontal bars. Therefore, the path from horizontal bars to gymnastics may have been laid from that time. We applied the wavelet interpolation model to the accomplishment rate for the back hip circle in young children, and described the development curve of that accomplishment rate. We then considered the level of physical maturity associated with the accomplishment rate from the behavior of the development velocity curve, and investigated whether the back hip circle accomplishment rate on the horizontal bar was linked to identification of subsequent talent in gymnastics. The results showed that when the behavior of the accomplishment rate velocity curve was compared in boys and girls, the peak velocity in girls was already detected at around the age of 3–4, and maturity was clearly earlier. The ability to comply with a sequence of movements (sequence compliance ability) was examined only in young children, but girls were superior to boys in that ability and girls also had a higher accomplishment rate in the back hip circle. Thus, a close relationship between non-cognitive ability and the back hip circle accomplishment rate may be conjectured. The accomplishment rate curve for back hip circles shows a neural pattern, like the development curve for the 50-m dash, and is dependent on a neural pattern. Thus, performance in the back hip circle can be evaluated from an early stage, and since an element of gymnastics can be distinguished, it may be a barometer for judging gymnastics talent, including genetics. Abilities that show a neural development pattern have a high genetic component, and genetic traits are expressed from early childhood and are highly likely to trace until adulthood. Therefore, in such individuals the physical abilities of coordination, flexibility, quickness, balance, and endurance are superior, and the back hip circle is accomplished early. The possibility was shown this early accomplishment of the back hip circle and the conditions of short height and low body weight are very important information in talent identification for gymnastics.

Keywords: Back Hip Circle, Talent Identification, Accomplishment Rate, Fujimmon Growth Curve

1. Introduction

Becker [1] proposed a human capital theory in which education, if understood as an economic activity, can be interpreted as an investment in the future. Heckman and Krueger [2] analyzed the rate of return on human capital investments by life stage. The results showed that the rate of return was the highest for preschool children and afterward continued to decline. They suggested that investment in human capital is better done when children are small, and advocated the importance of preschool education. Heckman [3] compared groups in which an advanced learning program was and was not

applied in early childhood, and found that the effect on cognitive abilities, such as IQ and learning ability, were sustained only temporarily and that by around 8 years old there was no longer any difference with other children. However, while high levels of cognitive ability such as IQ and learning ability were not sustained over the long term, things such as motivation, perseverance, sociability, and self-control, called non-cognitive abilities, were sustained. Nakamuro [4] reported that non-cognitive abilities have a large effect on success in work environments. Non-cognitive abilities are thought to be equivalent to the “life ability” that is currently spoken of in Japan to indicate certain personality traits in people.

In Japan, “life ability” as non-cognitive ability has a history of being cultivated during children’s play. For example, in games such as “tag,” “hide and seek,” and “kick the can,” children naturally acquire sociability and perseverance in the process of playing hard within the rules. More athletic play on horizontal bars and jungle gyms in schoolyards fosters motivation and a sense of accomplishment, and the non-cognitive ability of “life ability” is thought to be developed in the process of experiencing these different kinds of play. In Japan, students attempt the back hip circle in physical education class in school. It may be considered a simple teaching material through which children can experience feelings of achievement and pride. A major factor behind this is that schoolyards in Japan do not have an environment for gymnastics, equipped only with horizontal bars. Therefore, the path from horizontal bars to gymnastics may have been laid from that time. Many children, in the process of learning the back hip circle, have cultivated the non-cognitive abilities that also lead to making effort, conquering tasks, and “life ability.”

The back hip circle may also be considered a gateway to success in gymnastics. Thus, in children with a high accomplishment rate in the back hip circle, talent in gymnastics stemming from that accomplishment ability may be shown.

In this study, the wavelet interpolation model was applied to the accomplishment rate of children in the back hip circle on the horizontal bar, and the level of physical maturity associated with the accomplishment rate development was verified from the behavior of the accomplishment rate development velocity curve. Next, the relationship between the level of physical maturity and non-cognitive abilities (sequence compliance rate) in the back hip circle was explored, and, using the Fujimmon growth curves (Fujii [5]), a comparison was made of the development curve for the 50-m dash in boys and girls and the back hip circle accomplishment rate developmental curve. A previous study by Tanaka et al. [6] suggested the possibility that the back hip circle may be useful information in making decisions about athletic sense and a barometer of level of maturity. The purpose of this study was to explore the relationship between the back hip circle and talent in gymnastics.

2. Methods

2.1. Subjects and Measurements

The subjects were 581 children aged 2–12 (308 boys, 273 girls) who were enrolled in a gymnastics school. Their dates of birth were recorded and their precise age on the day of the measurements was calculated. The survey content and measurements were explained to subjects and their parents, and informed consent was obtained. None of the subjects had any acute or chronic disease.

2.2. Analysis

The back hip circle, a horizontal bar exercise, was

performed by the subjects. A judgment was made as to whether or not they performed the back hip circle successfully, and the back hip circle accomplishment rate was calculated. Next, non-cognitive abilities were surveyed in 3–6-year-old subjects (basic class). The survey was performed with reference to an experiment called the “marshmallow experiment” carried out by psychologist Walter Mischel and colleagues [7] to measure self-control. A behavior observation survey was performed with the instructor in each class visually checking sequence compliance in relation to self-control. Next, the calculated back hip circle accomplishment rate was described as the accomplishment rate curve on an age axis. The wavelet interpolation model advocated by Fujii [8] was applied to describe the accomplishment rate curve.

2.3. Analysis Method

Wavelet Interpolation Model

The wavelet interpolation model is a method in which interpolation between data points is done with a wavelet function to approximately describe the true growth curve from given growth data, and a growth distance curve is drawn. That growth distance curve is differentiated and a growth velocity curve is derived to examine the growth distance values of things such as pubertal peaks or the age at menarche. In terms of validity, the wavelet interpolation model sensitively reads local events and has a very high approximation accuracy. The details of the theoretical background and the evidence for its validity have already been described by Fujii [8], and so are omitted here. In this study, the wavelet interpolation model was applied to the back hip circle accomplishment rate corresponding to an age axis, and the velocity curve of the accomplishment rate was described.

2.4. Analytical Procedures

1. Children from the ages of 2 to 12 years old performed a back hip circle on the horizontal bar. A judgment was made as to whether or not each child performed the back hip circle successfully, and the accomplishment rate was calculated by age.
2. For the 3- to 6-year-old children (basic class), an experiment was conducted with reference to the experiment performed by the psychologist Mischel et al. [7] to measure self-control. This experiment was a behavioral observation of sequence compliance.
3. The calculated back hip circle accomplishment rate was described with the wavelet interpolation method as the accomplishment rate curve on an age axis.

3. Results

3.1. Back Hip Circle Accomplishment Rate Curve

Table 1 shows the back hip circle accomplishment rate in boys and girls. In 4.5-year-olds, it was 10% boys and 38% in girls; in 5.5-year-olds it was 56% in boys and 68% in girls; in 6.5-year-olds it was 56% in boys and 84% in girls; in

7.5-year-olds it was 85% in boys and 95% in girls; in 8.5-year-olds it was 95% in both boys and girls; in 9.5-year-olds it was 92% in boys and 93% in girls; and in 10.5-year-olds it was 100% in both boys and girls. The number N in 3.5-year-old children was low and so was omitted. Next, Table 2 shows the accomplishment rate and the sequence compliance rate in 3–6-year-old children. In boys the sequence compliance rate was 62% against an accomplishment rate of 45%, while in girls the sequence compliance rate was 79% against an accomplishment rate of 54%.

Table 1. Accomplishment rate in back hip circle.

Achievement rate of back hip circle							
Age (year)	4.5	5.5	6.5	7.5	8.5	9.5	10.5
Boys	10%	56%	56%	85%	95%	92%	100%
Girls	38%	68%	84%	95%	95%	93%	100%

Table 2. Accomplishment rate and compliance in 3–6-year-old children.

3~6 Age's Achievement rate and Compliance		
	Achievement rate	Compliance
Boys	45%	62%
Girls	54%	79%

Figures 1 and 2 are graphs of the wavelet interpolation model applied to the back hip circle accomplishment rate in boys and girls. The red marks are the accomplishment rate

development distance curve and the blue marks are the velocity curve. In boys, the velocity peaks in two places, and the first peak is the largest. The age of about 4.5 years old is the peak for back hip circle accomplishment, and is conjectured to be a critical point in development. In girls, on the other hand, the accomplishment peak had already been detected and the period from 3 to 4 years old is conjectured to be a critical period in development.

Figures 3 and 4 are graphs of the wavelet interpolation method applied to development growth distance values in the 50-m dash for 6–17-year-old boys and girls. In boys, the peak in velocity appears after the age of 6, and the first peak, appearing at around 6.5 years old, is the largest. Afterward, the velocity decreases and the development pattern in the 50-m dash does not show a pubertal peak. In other words, it shows a curve close to that of a so-called neural development pattern. In girls, on the other hand, an accomplishment peak was detected at around 6 years old and the velocity peak was reached at an earlier time than in boys. Thus, it was seen that there was greater dependence on a neural development pattern in girls than in boys. A point shown in the development pattern for the 50-m dash is that it is very similar to the development pattern in the back hip circle accomplishment rate. This is thought to be a finding suggesting that the development pattern of the back hip circle accomplishment rate depends more on the neural pattern.

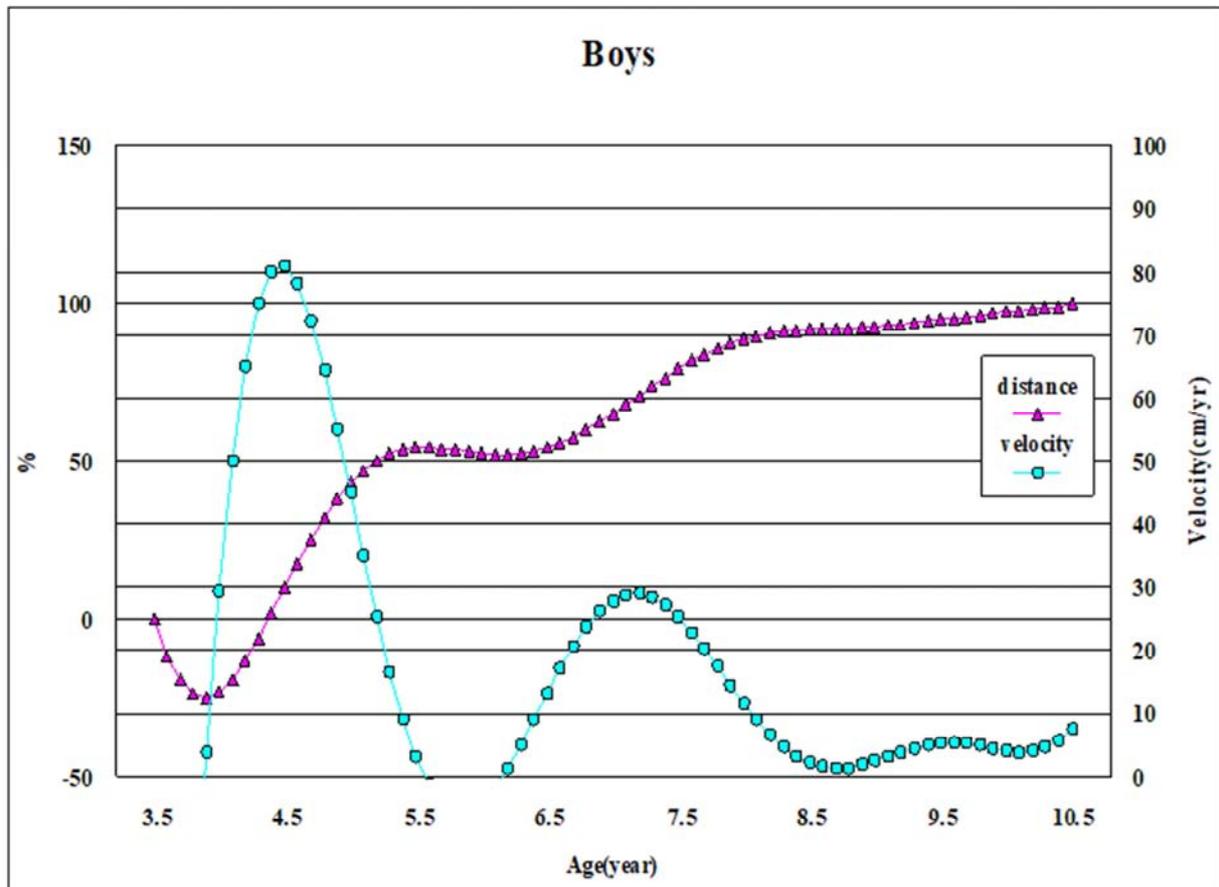


Figure 1. Back hip circle accomplishment rate development and velocity curves in boys.

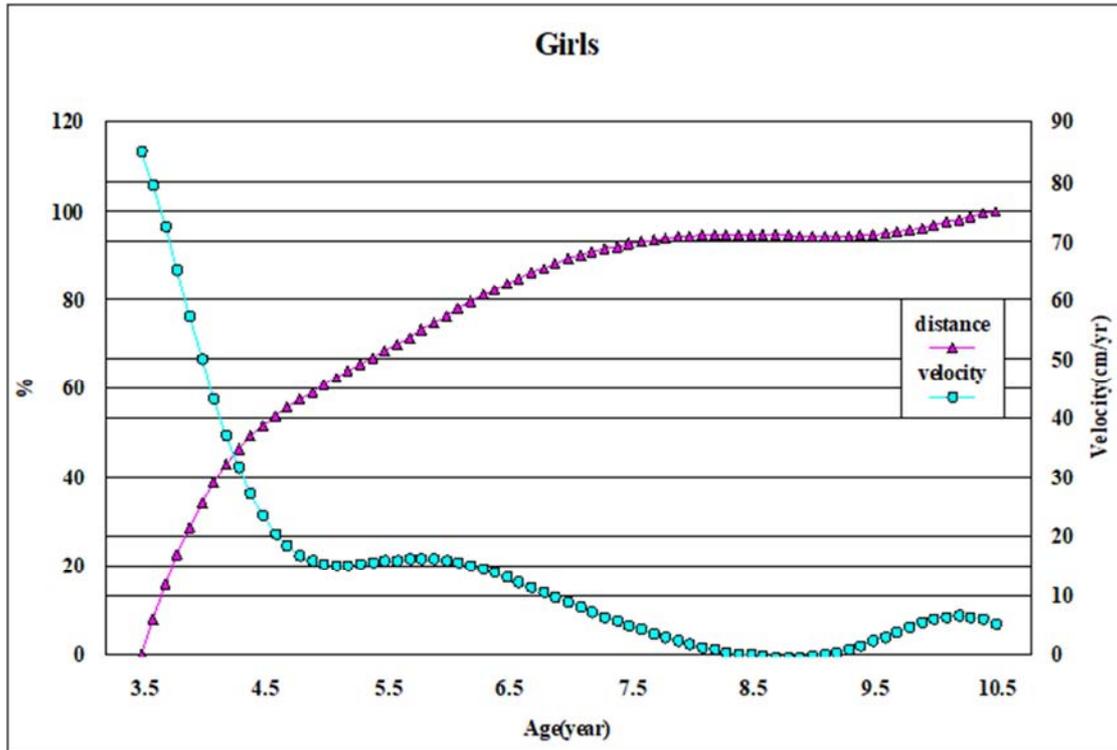


Figure 2. Back hip circle accomplishment rate development and velocity curves in girls.

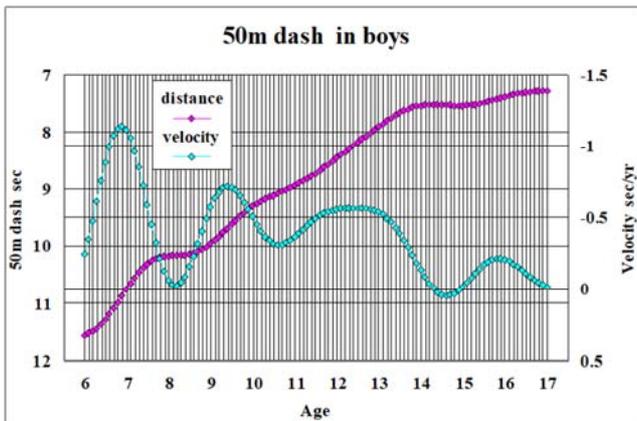


Figure 3. Development distance and velocity curve for 50-m dash in boys.

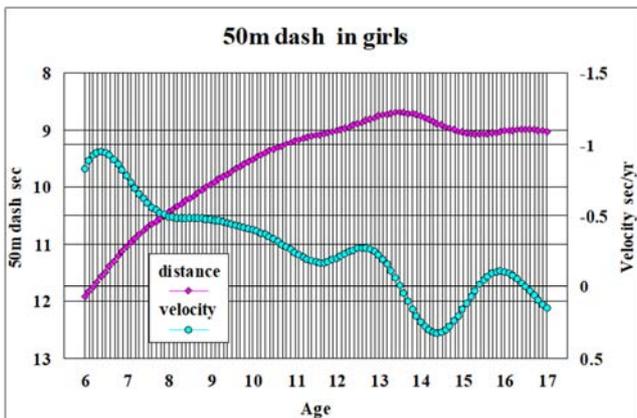


Figure 4. Development distance and velocity curve for 50-m dash in girls.

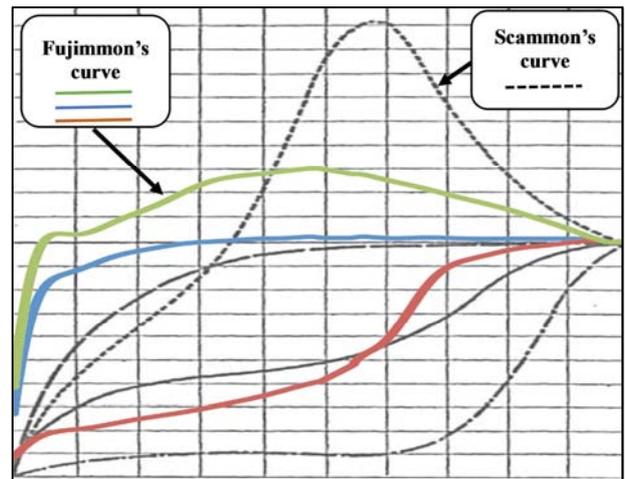


Figure 5. Comparative growth curve of Fujimmon and Scammon.

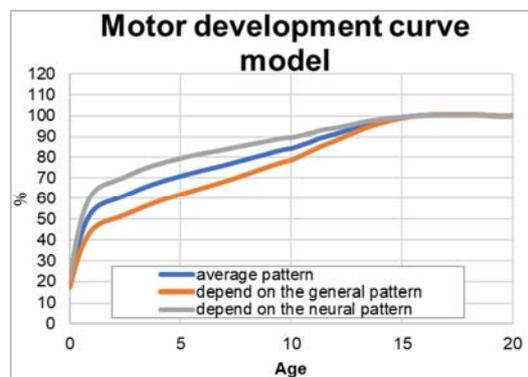


Figure 6. Motor development curve model based on Fujimmon's growth curve.

3.2. Motor Ability Development Curve Model Based on Fujimmon Growth Curves

Figure 5 shows comparative growth curves of Fujimmon and Scammon. The Fujimmon growth curve is a theory that proposes a new standard growth pattern for humans after Fujii [8] re-examined the Scammon growth curves and proposed three patterns, neural, lymphatic, and general, by including the genital type in the general type. Judging from the Fujimmon growth curves, the back hip circle accomplishment rate curve and the 50-m dash development curve are seen to depend on the neural pattern. The motor development curve model in Figure 6 shows this more clearly. This development curve model is a proposed motor development curve model centered on an average development curve, with an upper development curve model as a type that depends more on the neural pattern and the lower development curve model as a type that depends more on a general pattern. Judging from this development curve model, it is seen that the back hip circle accomplishment rate curve and the 50-m dash development curve are similar to the upper development curve model, which is a type that depends more on the neural pattern.

4. Discussion

In a comparison of the behavior of the velocity curve for the back hip circle accomplishment rate development in boys and girls, the velocity peak for girls was already detected at around the age of 3–4, revealing clearly earlier maturation. Fujii [9] has indicated that physical maturity comes earlier in girls than in boys, which would suggest that level of maturity contributes greatly to development of the physical skill in the back hip circle. Judging from the velocity curve for the back hip circle accomplishment rate, boys show a characteristic trend in which the velocity curve decreases markedly from 4.5 to 5.5 years old. The timing of the decrease in girls is 3.5–4.5 years old, earlier than in boys, which is thought to be a factor of greater precociousness in girls than in boys. The sequence compliance ability was tested only in young children, but girls were superior to boys in that ability and since girls also have a higher back hip circle accomplishment rate it may be conjectured that there is a close relationship between non-cognitive abilities and the back hip circle accomplishment rate.

The development curve for the 50-m dash, if based on the Fujimmon growth curves, shows a clear neural pattern. Thus, since growth of nervous system elements is accomplished in early childhood, it is possible to evaluate abilities associated with nervous system development, such as the 50-m dash, since they are accomplished early. Therefore, genetic involvement can also be judged at an early stage, and this is promising from a talent identification outlook. The back hip circle accomplishment rate curve, like the 50-m dash development curve, shows a neural pattern if based on the Fujimmon growth curves. If based on the motor development curve model, it clearly approximates the upper development curve model and shows a development pattern that depends on

the neural pattern. Thus, ability in the back hip circle, like the 50-m dash, can be evaluated from an early stage and an element of gymnastics can be distinguished. It could therefore be a potential barometer for judging talent in gymnastics. Of course, it would be difficult to distinguish gymnastics talent simply by judging whether or not a back hip circle can be accomplished. However, since a back hip circle can be accomplished at an early stage in childhood, one cannot rule out the possibility that it suggests gymnastics talent, including genetic elements.

When Fujii *et al.* [10, 11] and Ogura *et al.* [12–14] compared the overall physiques in groups of general university students and elite athletes; they indicated that tall height is an advantage in sports. Shitara *et al.* [15], Ikeda *et al.* [16], and others have also shown that tall height is a major element among the physical elements of elite athletes. However, it has been reported that, compared to other sports, the physique of both male and female gymnasts is special in that they tend to be shorter [17, 18]. As a characteristic of the abilities of gymnasts, Yoshizawa *et al.* [19] reported that strength is on the whole excellent, including that strength per unit of body weight is considerably higher than among other athletes. They also noted that flexibility is superior, of which forward bends for girls in particular are a necessary condition. Ogata *et al.* [18] also listed coordination, flexibility, power, vestibular nerve balance, endurance, and high anaerobic power.

The back hip circle is the most basic technique in gymnastics, and is very closely related to neural-type development. It does not need to be said that those abilities are also necessary from the structure of the technique. There is a high genetic component in skills that show a neural development pattern. Fujii *et al.* [10] and Ogura *et al.* [20] have reported that genetic traits are expressed from early childhood and that there is a high likelihood that these traits track until adulthood. Thus, the fact that the quality of having high motor ability was shown to track from early childhood until adulthood, and not only in skills that follow a neural development pattern, may be considered a new finding.

Children that learn the back hip circle at the earliest time are precocious but also have marked neural development. If that trait tracks until adulthood, their physical abilities of coordination, flexibility, quickness, sense of balance, and endurance should be excellent, and accomplishing the back hip circle early and the conditions of short height and low weight could be considered very important information for use in identifying gymnastics talent.

5. Conclusion

In this study, the wavelet interpolation model was applied to the back hip circle accomplishment rate in young children, who in previous studies have been said to have a high rate of return to society. The development curve for the accomplishment rate was also described. Then, considering the level of physical maturity in the accomplishment rate from the behavior of the development velocity curve, we examined whether the accomplishment rate for the back hip circle on the

horizontal bar leads to identification of later talent in gymnastics. From a comparison of the behavior of the velocity curve for the back hip circle accomplishment rate in boys and girls, it was found that the peak velocity in girls was already detected around the age of 3–4, and their maturity is clearly early. Sequence compliance ability was only examined in young children, but that ability was superior in girls compared to boys. Since the back hip circle accomplishment rate was also higher in girls, it may be surmised that non-cognitive abilities are closely related to the back hip circle accomplishment rate. The back hip circle accomplishment rate curve shows a neural pattern, like the 50-m dash development curve, and depends on the neural pattern. Thus, ability in the back hip circle can be evaluated from an early stage, and since this element of gymnastics can be distinguished it may be a barometer for judging gymnastics talent, including genetics. In addition, abilities that show a neural development pattern have a high genetic component, and genetic traits are expressed from an early age and have a high likelihood of tracking until adulthood. With this, the physical abilities of coordination, flexibility, quickness, sense of balance, and endurance are superior, and the possibility was shown that accomplishing the back hip circle early and fulfilling the conditions of short height and low weight constitute especially important information in the identification of talent in gymnastics.

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